Water Conservation Plan

Pats Peak Snowmaking System

Henniker, NH

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DES/DWGWB
By

The following information is being furnished as required as a condition in the Water Quality Certificate: # 2012-404P-003 issued to Pats Peak Ski Area located at 686 Flanders Road in Henniker, NH 03242. This Water Conservation Plan has been prepared in accordance with: Env-Wq 2101, Water Conservation rules, and particularly Env-Wq 2101.08 Requirements for Industrial, Commercial, and Institutional Water Users (ICI) right conditions. When operational conditions dictate the Whisper Reservoir is opened transferring water to the Lower Pond. High pressure pumps housed in a building adjacent to the Lower Pond pushes the water to a piping network which covers 100% of our skiable terrain which is essential in Southern New Hampshire. Two large diameter pipes line the sides of each ski trail. One pipe contains pressurized water and the other contains pressurized air with hydrant locations approximately every 100'. Both ingredients are brought together inside a snowgun where the water particle is atomized and nucleated into a smaller droplet, by the blast of the compressed air, which results in machine made snow.

Env-Wq 2101.08 – Requirements for Industrial, Commercial, and Institutional Water Users (ICI)

A: ICI Water users shall identify the location and amount of water used for existing and anticipated future uses of water associated with the following:

1. ***Heating***
2. ***Cooling***
3. ***Processing***
4. ***Product Ingredient***
5. ***Sanitary use***
6. ***Outdoor water use.***

Pats Peak currently uses water for cooling and product ingredient. Existing permits allow us to withdraw water at the following rates:

- 1,000 gallons/per minute from the Craney Pond source and
- 250 gallons/per minute out of Chase Brook.

The water from Craney Pond is pumped to and then stored in the Whisper Reservoir and water from Chase Brook is stored in the Lower Pond until needed for snowmaking operations.

Cooling: Recirculating cooling techniques are applied to this operation. Water is used to cool the compressed air which is used for snowmaking operations. Cooling of the compressed air is done to remove moisture and minimize ice buildup in pipelines and hoses. The compressed air is cooled, via water jacket tubes (RP Adams Aftercooler SAF-983). The after coolers pull their water from the Lower Pond. The water is then pumped uphill of the Lower Pond about two hundred vertical feet. The water then trickles back down the mountain; the associated cooling that occurs, via reintroduction of ambient air, cools the water as it returns to the Lower Pond where the cycle starts over. The water is constantly recycled and recirculated and we do not discharge the water to waste.

Product Ingredient on any given year approximately 55,000,000 to 65,000,000 gallons of water is used in our snowmaking operation. Water is transformed into snow through a series of pipelines and snowguns throughout our ski area.

D: Processes that result in the discharge or disposal of unused water shall be identified and modified as described below:

1. ***Any process where water is used to control temperature shall be identified and***
2. ***Any process where water within a given process may be discharged or otherwise disposed of unused through and overflow shall be identified.***

Over the last 10 years the snowmaking system has been reconfigured into a reclaiming loop system per the design specifications of Snomatic Engineering (see enclosed PDF of system layout dated April 2003). Of the two remaining one way end lines a bleeder snowgun is run at the end of one and the other one line was made frost free eliminating the need for discharge. When the system is under pressure and producing all water is utilized. When system shut down is occurring and water is drained from the system, to prevent freezing, all water in the lines is converted to the snow until water pressure is less then 100 psi. Pressures below 100 psi are not conducive to snowmaking. At that point, snowmaking equipment is turned off and the remaining water, in the pipelines, is drained back to the Lower Snowmaking Pond.

E: Processes identified in (d), above, shall be modified within 5 years of initiating a withdrawal from a new source of water by using one or more of the following methods:

1. ***Automatic shut-off devices preventing the discharge of water to waste shall be installed for all processes identified in (d) above; and***
2. ***Sensors that optimize the use of water shall be installed for all processes identified in (d) above.***

The master plan for the snowmaking system shows expansion with additional return loops. No bleeder valves will be deployed.

F: Water Conservation practices not described in paragraphs (a) through (e) above, shall be implemented and described below:

1. ***The water user shall provide the department a description of water conservation best management practices of best available technologies that might be applicable to the types of water using processes at the facility;***
2. ***The water user shall develop a plan and schedule to implement the plan that demonstrates these processes will be implemented within 5 years; and***
3. ***The water user shall implement the plan according to the schedule upon obtaining approval from the department pursuant to Env- WQ 2101.12***

Surface water withdrawals for snowmaking are seasonal and generally limited to a 90 day period. During this period Pats Peak will pump from Craney Pond on average 20-25 days and 35-50 days from Chase Brook. Snowmaking operations commence in mid-November with a primary goal of limited lift/terrain operations by the Thanksgiving holiday. The secondary goal of the snowmaking system is to have 100% of our lifts/terrain open for the all-important Christmas holiday period.

(depending on which trail will receive snow). In a low pressure system, a fan is used to propel water into the air. In both systems, as water droplets combine with dust particles in the air, water particles are nucleated and fall to the ground as snow.

Pats Peak uses three methods to control the snowmaking equipment that are in service: automated, semi-automated, and manual. All (but three) of the 23 trails are serviced by manually-controlled snowmaking equipment. Manually-controlled equipment is individually adjusted for maximum efficiency and serviced by a full-time snowmaking crew on an hourly basis. The three trails that are not manually-controlled are serviced completely by automated snow guns. Automated snow guns are regulated via computer sensors; these sensors turn the guns on and off and regulate gun water flow to minimize waste and maximize snowmaking capacities given air temperature and humidity conditions. Currently, there are approximately 500 snow guns used to make snow on Pats Peak; almost all are tower mounted to achieve better "hang time" and to convert water using as little power as possible.

Pats Peak has three distinct exposures and we have many areas where we can hide during high wind events. Wind mainly affects the three most exposed trails (Twister, Race Trail, and Hurricane). Excessive wind leads to a poor ROI as it relates to energy and water input. In general when looking at wind the decision to continue snowmaking operations is figured on the following criteria:

- Wind direction
- Wind speed
- Overall objective for snowmaking. Can we hide on an exposure of the mountain not subject to wind?

Accordingly, it's not in our interest to blow snow when winds and cold temperatures are excessive.

The snowmaking system at Pats Peak is a highly refined state-of-the-art system which achieves maximum utilization of the water available for snowmaking. In addition to the equipment described above, the Peak has a dedicated and experienced crew which makes adjustments to the system during operations to maximize the efficiency of water usage.

In the last 10 years Pats Peak has invested very heavily in one of the most modern styles of snowmaking equipment: fan snowmaking (i.e. the ***SMI PoleCat)*** It is one the most popular fan snowmakers in the world. The PoleCat is a very effective water to snow converter in terms of cost per cubic foot of snow and water to snow conversion rates. The PoleCat uses bigger spray droplet technology and is a good balance between particle freezing and snow grain landing on the slope in the position desired by the resort. For comparison purposes, SMI's older technology Wizard multi-nozzle snowmaker uses 375 nozzles whereas the PoleCat uses 30 nozzles. The multi-nozzle snowguns works very well with clean water in marginal conditions and no winds. However, they do produce smaller droplets and drift more. Additionally high capital costs keep the installation of these units in the 4-6 machines per year. Technology is always changing and depending on what we are trying to accomplish will dictate purchases as it relates to snowmaking. We do anticipate that we will continue to make significant documented and the line is allowed to "stand overnight". If a leak is detected through pressure loss the line is walked and the source is found and corrected. Repairs are photographed and chronicled in our snowmaking photos file directory. Each year on average more than 3,000 feet of pipe of our fixed asset inventory is replaced. Overall, Pats Peak's pipeline inventory is in excellent shape.

G: ICI water users shall not be required to implement a measure described in (c) through (f), above, if an economic analysis prepared by a person employed or contracted by the water system who has the training and experience in preparing economic analysis shows that the payback period for the measure is more then 4 years.

Pats Peak will follow the current operating procedures as it relates to conservation of water resources. It is not anticipated that an economic analysis will be performed for the snowmaking operation. Therefore item 2101.08 (C) through (F) is not applicable. The option of performing an economic analysis in the future pending system audit/review.

H: The economic analysis is (g) above, shall factor in the true cost of water use, including:

1. ***The cost of energy to pump and transmit water;***
2. ***The cost of treating pumped water;***
3. ***Cost of disposal of wastewater***
4. ***Capital costs or fees associated with developing new sources of water; and***
5. ***All other costs or fees associated with obtaining or disposing of the water***

Pats Peak will follow the current operating procedures as it relates to conservation of water resources. It is not anticipated that an economic analysis will be performed for the snowmaking operation. Therefore item 2101.08 (H) is not applicable

I: The department shall approve the economic analysis in (g), above, if the analysis:

1. ***Contains all of the information required by (h), above; and***
2. ***Is accurate***

Pats Peak will follow the current operating procedures as it relates to conservation of water resources. It is not anticipated that an economic analysis will be performed for the snowmaking operation. Therefore item 2101.08 (I) is not applicable.

J: If an ICI water user is establishing new lawns, it shall immediately implement the water efficiency process:

1. ***All new automatic watering devices used to irrigate the lawns, shall be equipped with technology that will prevent the systems from starting automatically and that will shut down the systems when not needed:***

Wet Bulb Chart

Snowmaking Temperature & Humidity Guide

Air Temperature °F	20%	30%	40%	50%	60%	70%	80%	90%	100%	Snow Quality Key
	Relative Humidity % / **Wet Bulb Temperature °F**									Ideal / Marginal / Not Possible
14.0	9.9	10.4	10.9	11.5	12.0	12.4	12.9	13.5	14.0	Ideal Snowmaking Conditions
15.8	11.3	11.8	12.4	12.9	13.5	14.0	14.7	15.3	15.8	
17.6	12.7	13.3	13.8	14.5	15.1	15.8	16.3	16.9	17.6	
19.4	14.0	14.7	15.4	16.0	16.7	17.4	18.0	18.7	19.4	
21.2	15.4	16.2	16.9	17.6	18.3	19.0	19.8	20.5	21.2	
23.0	16.9	17.6	18.3	19.0	19.9	20.7	21.4	22.3	23.0	Marginal Snowmaking Conditions
24.8	18.2	19.0	19.8	20.7	21.6	22.3	23.2	23.9	24.8	
26.6	19.6	20.5	21.4	22.1	23.0	23.9	24.8	25.7	26.6	
28.4	20.8	21.9	22.8	23.7	24.6	25.5	26.6	27.5	28.4	
30.2	22.3	23.4	24.3	25.3	26.2	27.3	28.3	[illegible]	[illegible]	[illegible]
32.0	23.7	24.6	25.7	26.8	27.9	[illegible]	[illegible]	[illegible]	[illegible]	
33.8	26.0	26.1	27.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
35.6	26.4	27.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
37.4	27.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
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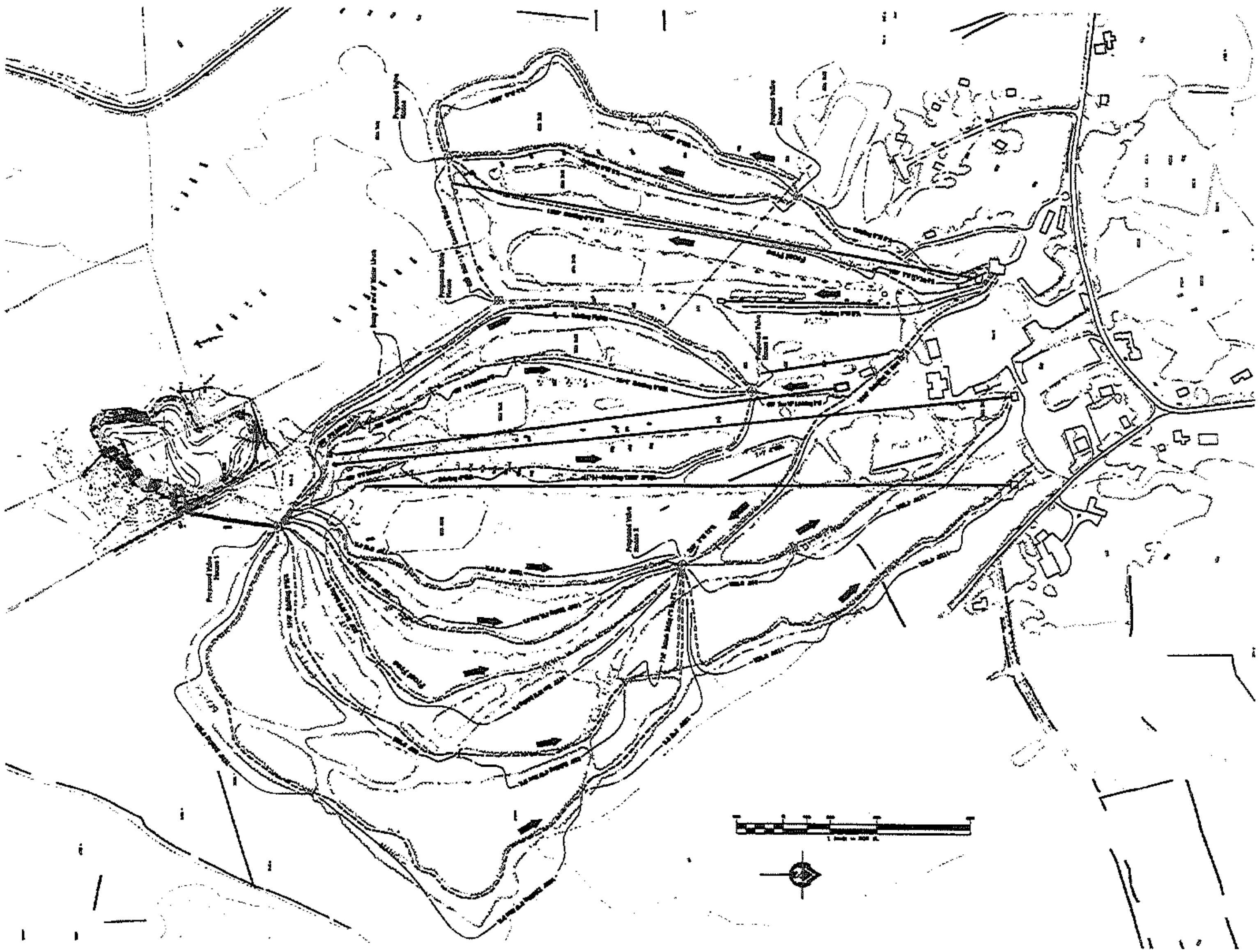

REVISIONS

No.	DATE	DESCRIPTION	DRAWN BY	APP'D BY

NOTES / LEGEND

- EXIST PIPE
- SNOWMAKING PIPE AIR ONLY
- PROPOSED PIPE
- PROPOSED MAIN FEED PIPE
- PROPOSED VALVE HOUSE

DRAFT

FOR REVIEW ONLY, NOT FOR CONSTRUCTION

PATS PEAK

Snomatic Controls and Engineering Inc.

CLIENT

PATS PEAK SKI RESORT

PROJECT TITLE

PATS PEAK SNOWMAKING SYSTEM

DRAWING TITLE

Proposed Piping 2003

Designed by	Approved by
S. Barthold	–
Project no.	**Drawn by**
085.7	J. Wilkinson
Date	**Scale**
4/11/03	1" = 200'-0" D SIZE
Drawing no.	**Sheet no.**
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GE
Sensing

AT868 Specifications

Operation and Performance

Fluid Types
Acoustically conductive fluids, including most clean liquids, and many liquids with entrained solids or gas bubbles. Maximum void fraction depends on transducer, interrogation carrier frequency, path length and pipe configuration.

Pipe Sizes
- Clamp-on transducers: 0.5 to 300 in. (12.7 mm to 7.6m) and larger
- Wetted transducers: 1 in to 200 in (25.4 mm to 5 m) and larger

Pipe-Wall Thickness
Up to 3 in (76.2 mm)

Pipe Materials
All metals and most plastics. Consult GE for concrete, composite materials, and highly corroded or lined pipes.

Clamp-On Flow Accuracy (Velocity)
- Pipe ID>6 in (150 mm): ±1% to 2% of reading typical
- Pipe ID<6 in (150 mm): ±2% to 5% of reading typical

Wetted Flow Accuracy (Velocity)
±1% of reading typical

Accuracy depends on pipe size and whether measurement is one-path or two-path. Accuracy to ±0.5% of reading may be achievable with process calibration.

Repeatability
±0.1% to 0.3% of reading

Range (Bidirectional)
–40 to 40 ft/s (–12.2 to 12.2 m/s)

Rangeability (Overall)
400:1

Specifications assume a fully developed flow profile (typically 10 diameters upstream and 5 diameters downstream of straight pipe run) and flow velocity greater than 1 ft/s (0.3 m/s).

Measurement Parameters
Volumetric flow, totalized flow and flow velocity

Electronics

Flow Measurement
Patented Correlation Transit-Time mode

Enclosure
Epoxy-coated aluminum weatherproof Type 4X/IP66

Dimensions
Standard: Weight 2 lb (0.9 kg),
size (h x w x d) 7.25 in x 5.9 in x 3.5 in
(184 mm x 150 mm x 89 mm)

Channels
- Standard: One channel
- Optional: Two channels (for two pipes or two-path averaging)

Display
2-line x 16 character backlit LCD display, configurable to display up to four measurement parameters in sequence

Keypad
Six-button internal keypad

Power Supplies
- Standard: 85 to 265 VAC, 50/60 Hz
- Optional: 12 to 28 VDC, ± 5%

Power Consumption
20W maximum

Operating Temperature
14°F to 131°F (–10°C to 55°C)

Storage Temperature
–40°F to 158°F (–40°C to 70°C)

Standard Inputs/Outputs
- One 0/4 to 20 mA isolated output per channel, 600 Ω maximum load
- One frequency/pulse rate/totalizer output per channel, optically isolated, 3A maximum, 100 VDC maximum, 1W maximum, from 0.1 to 10 kHz

GE
Sensing

Applications

The AquaTrans AT868 liquid flow transmitter is a complete ultrasonic flow metering system for measurement of:

- Potable water
- Wastewater
- Sewage
- Discharge water
- Treated water
- Cooling and heating water
- Other liquids

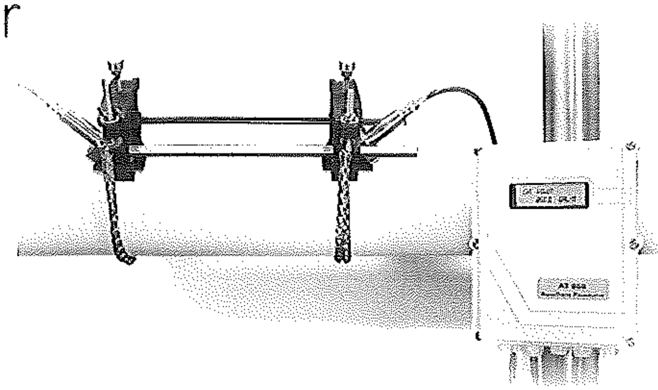
Features

- Economical non-intrusive flow measurement
- Simple setup and installation
- Suitable for wide range of pipe sizes and materials
- Suitable for lined pipes
- Two-channel/two-path version available
- Velocity, volumetric and totalized flow
- Internal keypad for field programming

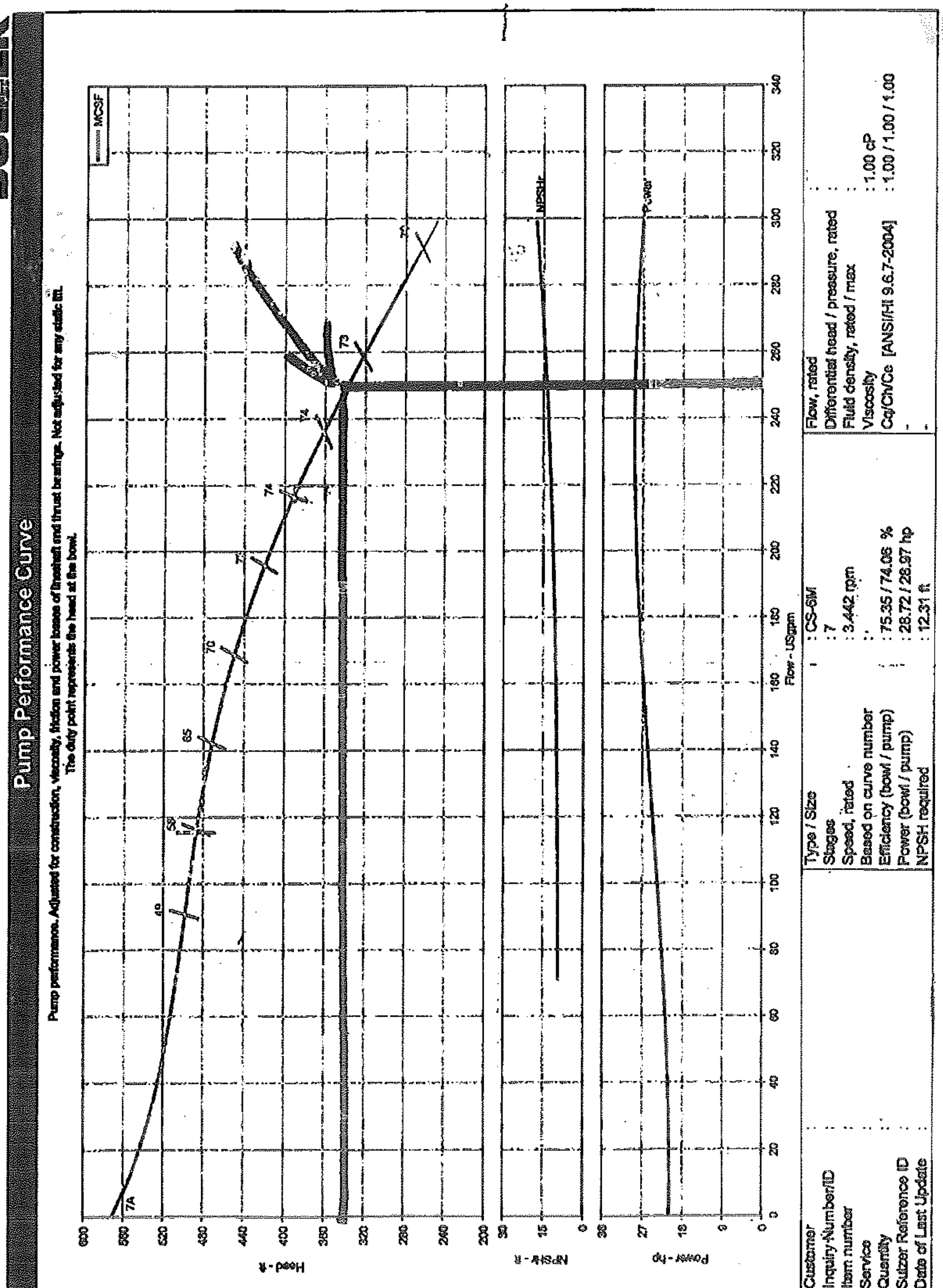
AquaTrans™ AT868

Panametrics Ultrasonic Liquid Flow Transmitter

AquaTrans AT868 is a Panametrics product. Panametrics has joined other GE high-technology sensing businesses under a new name—
GE Industrial, Sensing.

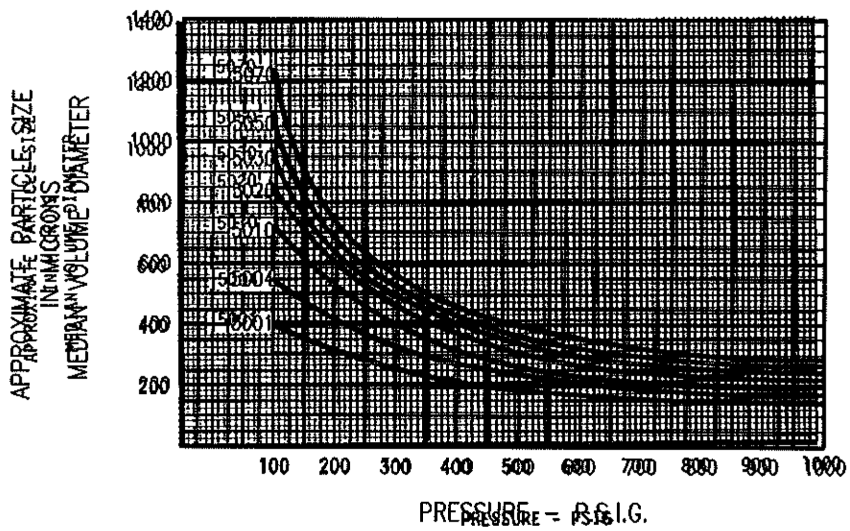


Chase Brook Pump Curve

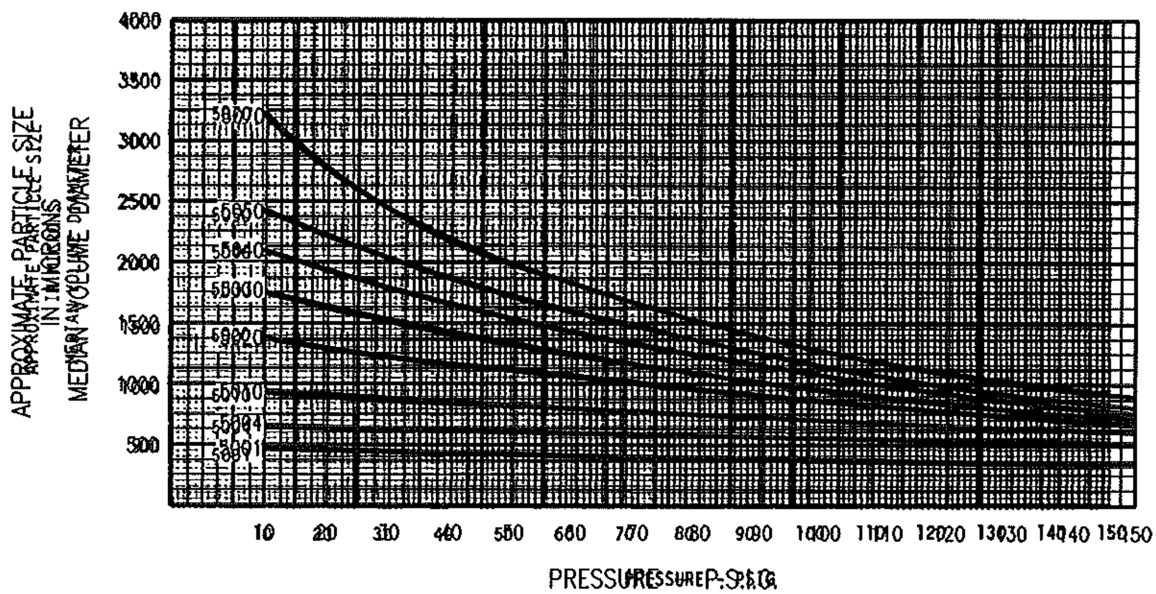


PARTICLE SIZE VS. PRESSURE

50° SERIES FLAT SPRAY NOZZLES
CAPCITIES 5001 THRU 5070
BASED ON WATER AT 70°F



Data is based on spraying water under laboratory conditions using Spraying Systems Co. Imaging Particle Analyzer.



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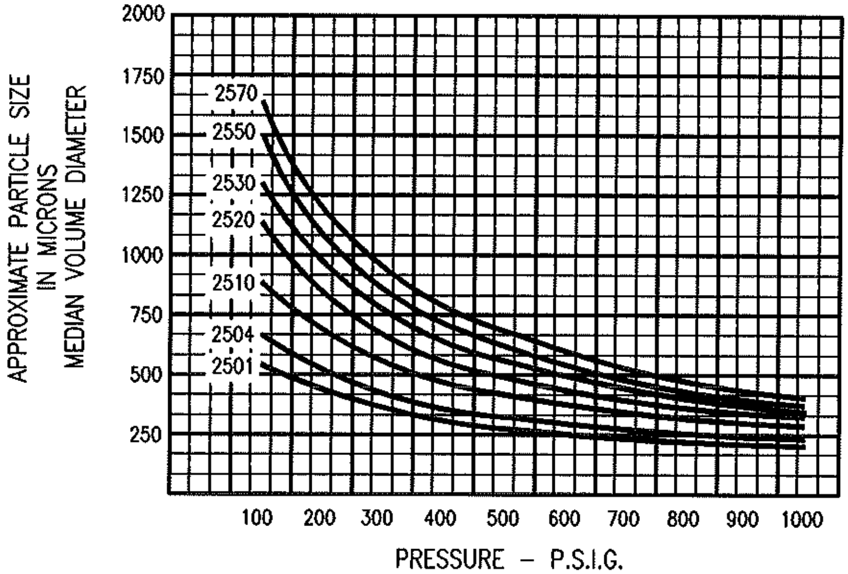
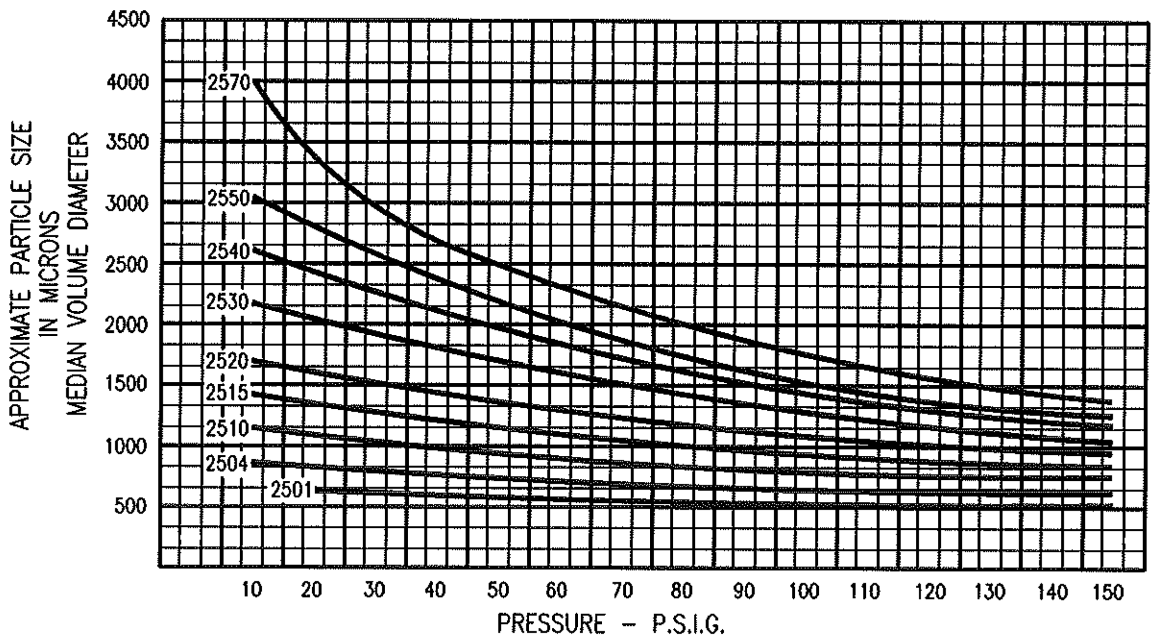
	Date:	

SPRAY PARTICLE SIZE V.S PRESSURE

25° SERIES FLAT SPRAY NOZZLES
CAPACITIES 2501 THRU 2570
BASED ON WATER AT 70°F





Spraying Systems Co.®
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Date:	11825-2A